CERTIFICATE

I certify that this thesis entitled **"PERFORMANCE EVALUATION OF PERCEPTUAL QUALITY AND INTELLIGIBILITY OF ENHANCED SPEECH USING MACHINE LEARNING AND DEEP LEARNING ALGORITHMS"** submitted for the degree of Doctor of Philosophy (Ph.D.) in Biomedical Instrumentation Engineering, is the record of research work carried out by **Mrs. Hepsiba. D (17PHEBP001)** during the period of her study from 2017 to 2022 in the Department of Biomedical Instrumentation Engineering at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, under my guidance and supervision, and the thesis has not formed the basis for the award of any Degree/Diploma/ Associateship/Fellowship or other similar titles of any candidate of Institute or any other University or Institution of Higher Learning.

11/11/22

Signature of HoD

11/11/22

Signature of the Supervisor

11/11/22

Signature of Dean

DECLARATION

I, **Mrs. Hepsiba. D**, hereby declare that this thesis titled **"PERFORMANCE EVALUATION OF PERCEPTUAL QUALITY AND INTELLIGIBILITY OF ENHANCED SPEECH USING MACHINE LEARNING AND DEEP LEARNING ALGORITHMS"** submitted to the Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, in the partial fulfilment of the requirements for the award of the Degree of **Doctor of Philosophy in Biomedical Instrumentation Engineering** is a record of original and independent research work done by me during the period from 2017 to 2022 under the guidance of **Dr. Judith Justin, M.Tech, Ph.D,** Professor and Head, Department of Biomedical Instrumentation Engineering, School of Engineering, Avinashilingam Institute of Home Science and Higher Education for Women and it has not formed the basis for the award of any Degree / Diploma / Associateship / Fellowship or any other similar titles in this Institute or any other University /other similar Institution of Higher Learning.

11/11/2022

Signature of the Candidate

11/11/22

Signature of the Supervisor

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HEPSIBA. D

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LIST OF ABBREVIATIONS

ANR	Adaptive Noise Reduction
APLT	Adaptive Power Law Transformation
AAS	Adversarial Acoustic and Supervision
AMS	Amplitude Modulation Spectrogram
AOS	Aphasia of Speech
ARCN	Attention based Redundant Convolutional Network
AI	Artificial Intelligence
ASR	Automatic Speech Recognition
BPN	Back Propagation Neural Network
BPCC	Bark Frequency Cepstral Coefficients
BSS	Blind Source Separation
CSTR	Centre for Speech Technology Research
CD	Cepstral Distance
CSE	Channel-wise Speech Enhancement
CASA	Computational Auditory Scene Analysis
CNN	Convolutional Neural Network
DBN	Deep Belief Network
DDAE	Deep Denoising Autoencoders
DFNN	Deep Fully Connected Neural Network
DNN	Deep Neural Network
DNSMOS	Deep Noise Suppression Mean Opinion Score
DCN	Dense Convolutional Network
DFT	Discrete Fourier Transform
DS	Double Spectrum
EAS	Electric and Acoustic Stimulation
EEMD	Ensemble Empirical Mode Decomposition
ERNN	Equilibrated Recurrent Neural Network
ERM	Estimated Ratio Mask
FWSegSNR	Frequency-Weighted Segmental SNR
FCN	Fully Convolutional Neural networks
FCRN	Fully Convolutional Recurrent Networks

GMM	Gaussian Mixture Model
GEV	Generalized Eigen Value
GDL	Generative Dictionary Learning
GA	Genetic Algorithm
HME	Heat Moisture Exchange
IRM	Ideal Ratio Mask
ILMSAF	Improved Least Mean Square Adaptive Filtering
IMCRA	Improved Minima Controlled Recursive Averaging
ICC	Inter Channel Correlation
ICM	Interaural Coherence Magnitude
ILD	Interaural Level Difference
ITU	International Telecommunications Union
IDFT	Inverse Discrete Fourier Transform
JDL	Joint Dictionary Learning
JSC	Joint Sparse Coding
K-SVD	K-Singular Value Decomposition
LTI	Linear Time-Invariant
LPS	Log-Power Spectrum
LSTM	Long Short-Term Memory
LPF	Low Pass Filter
MSE	Mean Squared Error
MFCC	Mel-Frequency Cepstral Coefficients
MMSE	Minimum Mean Square Error
MVDR	Minimum Variance Distortionless Response
ModSSub	Modulation Spectral Subtraction
MBE	Multi-Band Excitation
MNMF	Multichannel Nonnegative Matrix Factorization
MOCG	Multi-Objective Cycle GAN
NAT	Noise Aware Training
NMF	Non-negative Matrix Factorization
NCCC	Normalized Cross Correlation Coefficient
PESQ	Perceptual Evaluation of Speech Quality
POLQA	Perceptual Objective Listening Quality Analysis

PC	Phase Compensation
PSDs	Power Spectral Densities
PNCC	Power-Normalized Cepstral Coefficients
RCED	Redundant Convolutional Encoder-Decoder
RFM	Restricted Feature Mask
RNN	Recurrent Neural Network
segSNR	Segmental Signal to Noise Ratio
SI-SDR	Scale Invariant Signal to Distortion Ratio
SNR	Signal to Noise Ratio
STFT	Short Time Fourier Transform
STOI	Short-Term Objective Intelligibility
SRMR	Signal to Reverberant Modulation Ratio
SRU	Simple Recurrent Unit
SCSS	Single Channel Source Separation
SCM	Spatial Covariance Matrix
SSE	Spatial Speech Enhancement
SS	Spectral Subtraction
SSF	Spectral Subtraction Filter
SER	Speech Emotion Recognition
ASPP	Atomic Speech Presence Probability
SPP	Speech Presence Probability
SLP	Speech-Language Pathologist
STCNN	Stacked and Temporal Convolutional Neural Network
TCNN	Temporal Convolution Neural Network
TFSNN	Time–Frequency Smoothing Neural Network
TEP	Tracheoesophageal Prosthesis
TORS	Trans Oral Robotic Surgery
VAD	Voice Activity Detection
WaveCRN	Wave-Convolution Recurrent Neural Network
WSE	Wearable Speech Enhancement
WPE	Weighted Prediction Error
WER	Word Error Rate

WRR	Word Recognition Rate
ZNCC	Zero-mean Normalized Correlation Coefficient